U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-260 283

A STUDY OF COLORADO RIVER WATER QUALITY NEAR YUMA, ARIZONA

PUBLIC HEALTH SERVICE, DENVER, COLORADO

JUNE 1961

PB 260 283

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No. PB-260 283
4. Title and Subtitle A Study of Colorado River Water Quality Near Yuma, Arizona.			5. Report Date Jun 61 6.
7. Author(s) C. E. Sponagle, E. J. Pash, F. G. Baker, and H. R. Pahren			8. Performing Organization Rept. No. PR-1
9. Performing Organization Name and Address Public Health Service, Denver, Colo. Div. of Water Supply and Pollution Control.			10. Project/Task/Work Unit No. 11. Contract/Grant No.
12. Sponsoring Organization Name and Address			13. Type of Report & Period Covered 14.

15. Supplementary Notes
Report on Colorado River Basin Water Quality Control Project.

16. Abstracts Data reflecting the chemical quality of river waters and irrigation returns immediately above Yuma, Arizona, are provided, the results of a short field study conducted in 1961 by the Colorado River Basin Water Quality Control Project of the Public Health Service. Flow data at the seven sampling stations and laboratory analyses of the samples collected are reported.

11/30

17. Key Words and Document Analysis. 17a. Descriptors

17b. Identifiers/Open-Ended Terms
Colorado River Basin
Yuma (Arizona)
*Water quality
Chemical composition
Tables (data)
Federal agencies

17c. COSATI Field/Group 13B

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 14
	20. Security Class (This Page UNCLASSIFIED	22. Price $3.50/3.00

COLORADO RIVER BASIN WATER QUALITY CONTROL PROJECT
Public Health Service

BACKGROUND AND OBJECTIVES

The Colorado River Basin Water Quality Control Project was initiated by the Public Health Service at the request of the water pollution control agencies of the seven Basin States at a conference called by the Surgeon General in Phoenix, Arizona, January 13, 1960, under the provisions of Section 8, Public Law 660, 84th Congress, the Federal Water Pollution Control Act. The Project is consequently operating under the interstate enforcement provisions of the Act and is directed toward the accomplishment of the following objectives:

1. A determination of the specific pollutants and their concentrations which now exist or which may reasonably be expected to exist in the immediate future resulting from various water uses within the Basin, and the establishment of priorities for developing data on, and securing needed remedial action at the most critical and pressing problem areas.

2. A determination of methods for securing the best possible water quality for multiple water use and the development of a comprehensive plan and program of water quality control for multiple water use within the Basin which can serve as a guide for the conference and to State and Federal agencies having an interest in the prevention and control of water quality degradation.

Under the conference mechanism the official conferees consist of a representative of the Public Health Service and the water pollution control agencies of each of the States involved. The conferee group associated with this enforcement action is as indicated on the cover of this report.

ORGANIZATION

The Project Headquarters office, consisting of engineering and associated professional and clerical personnel, is located in Denver, Colorado. A laboratory for the sanitary analysis of samples collected has been established in Salt Lake City, Utah, and will provide the facility for radiological, bacteriological, biological, and chemical analyses of the various samples collected.

The Project is administratively attached to the Water Supply and Pollution Control program of the Public Health Service, Department of Health, Education, and Welfare, Region VIII, Denver, Colorado. The Water Supply and Pollution Control programs in DHEW Region VII, Dallas, Texas, and DHEW Region IX, San Francisco, California, are also cooperating with the Project, since portions of these regions lie in the Colorado River Basin.

A STUDY OF COLORADO RIVER WATER QUALITY NEAR YUMA, ARIZONA

by

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Public Health Service
Bureau of State Services
Division of Water Supply and Pollution Control

Colorado River Basin Water Quality Control Project
June 1961

ACKNOWLEDGMENT

The generous cooperation and assistance of the following are gratefully acknowledged: G. W. Marx and W. Gilbert of the Arizona Department of Health; D. Bryson of the U. S. Public Health Service, Region IX; C. J. Schmidt, T. P. Sullivan and D. Hovatter of the Arizona Water Company; C. C. McDonald, B. Irelan and A. Dalcerro of the U. S. Geological Survey, Yuma, Arizona; W. A. Steenbergen, L. C. Nicholson and M. M. Hastings of the Bureau of Reclamation, Yuma, Arizona; W. A. Von Schoeler and W. Emerson of the International Boundary and Water Commission, U. S. Section; J. A. Webb of the Yuma County Water Users Assn.; and R. C. Kroner and the staff of the National Water Quality Network Laboratory of the R. A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

INTRODUCTION

This is a report of a short field study conducted by the Colorado River Basin Water Quality Control Project of the Public Health Service in the Yuma, Arizona area during March, 1961, in cooperation with the Arizona Department of Health. Project personnel first learned of the degraded chemical water quality of the Colorado River in this area by correspondence of March 3, 1961, from the Public Health Service National Water Quality Network at Cincinnati.

Figure I is a plot of chloride and total hardness concentrations of the Colorado River water at the Yuma water intake during the period January 1960-April 1961. It will be noted that there was a sharp increase in both during the winter of 1960 and concentrations have remained since that time at substantially higher levels than previously existed.

This matter was discussed on March 9 with Mr. George W. Marx, Director, Bureau of Sanitation, State of Arizona Department of Health, and it was decided that the Project would conduct a short preliminary field survey of the chemical quality of river waters and irrigation returns immediately above Yuma.

PERSONNEL

The survey was carried out by Messrs. Herbert Pahren, Frederick Baker, and Edgar Pash of the Public Health Service, Colorado River Basin Water Quality Control Project, along with Mr. Dale Bryson of the Public Health Service Region IX office and Mr. Wilfred Gilbert of the Arizona Department of Health. Samples were collected during the period March 25 to 28, 1961. The sampling period was divided into two cycles: March 25-26 and March 27-28. Thus, two 2-day composites were collected at each sampling station.

SAMPLING STATIONS

Sampling stations were established as indicated in Table I and Figure II. The sampling locations were chosen by Project personnel and Mr. Gilbert of the Arizona Department of Health. Samples were collected daily by hand at each station during the sampling period.

FLOW DATA

Flows at stations 1, 3, and 5 were obtained from the U. S. Geological Survey, Surface Water Branch Office at Yuma, Arizona.

Flows at stations 2 and 7 were obtained from the Yuma Projects Office, Bureau of Reclamation, Yuma, Arizona.

Flows at station 6 were obtained from the International Boundary and Water Commission office, Yuma, Arizona.

Flows at station 4 were measured in the field by Project personnel using current meters supplied by the USGS Ground Water Branch, Yuma, Arizona.

Flows during each of the two sampling cycles are shown in Table II.

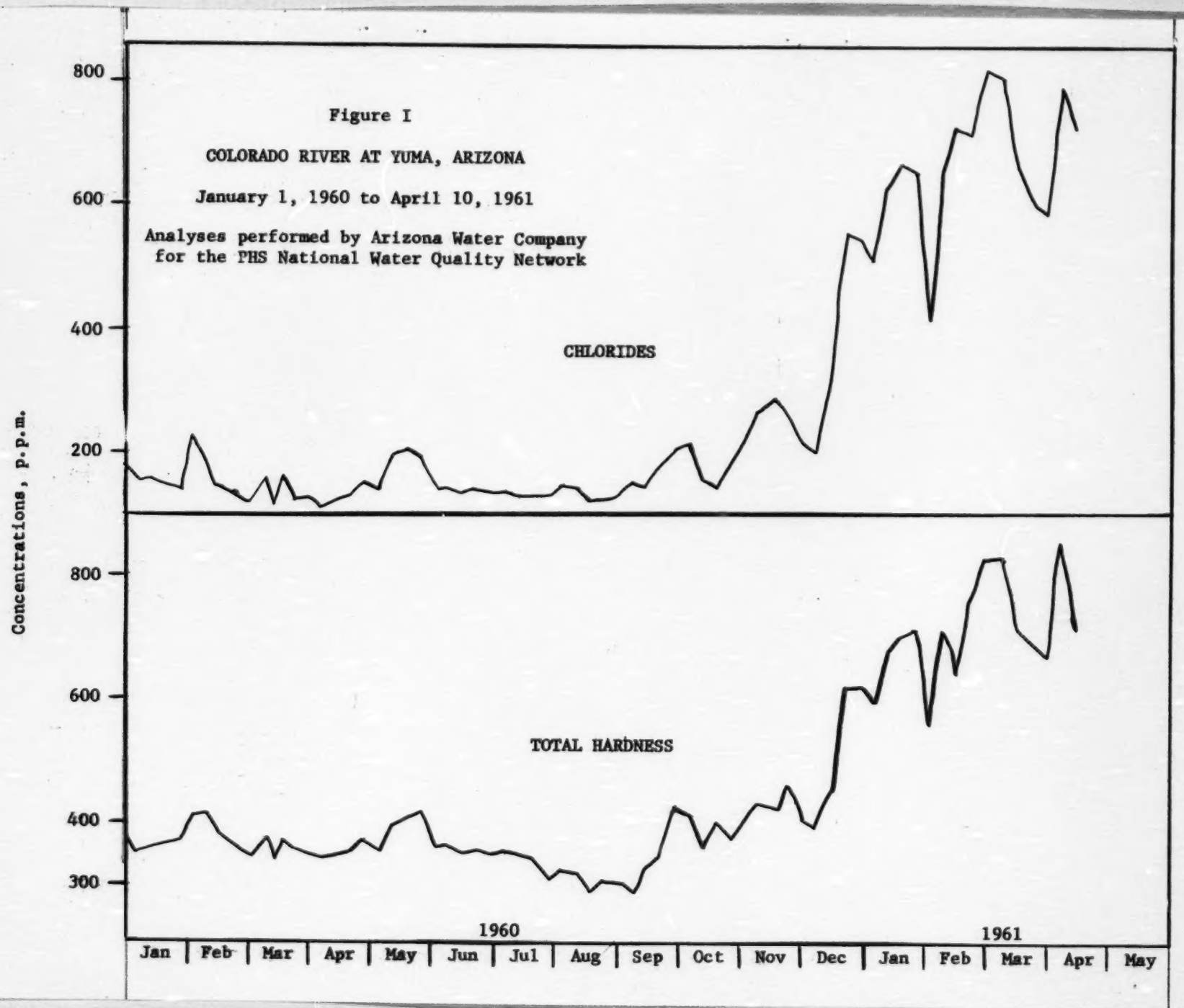


Figure I
COLORADO RIVER AT YUMA, ARIZONA
January 1, 1960 to April 10, 1961
Analyses performed by Arizona Water Company
for the PHS National Water Quality Network
CHLORIDES
TOTAL HARDNESS
Concentrations, p.p.m.
800
600
400
200
800
600
400
300
1960
1961
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May

TABLE I - SAMPLING STATIONS

Station Number	
1	Colorado River below Laguna Dam, from the California side approximately 100 yards below the dam
2	Wellton-Mohawk Canal, 1.0 miles west (upstream) of U. S. Highway 95; at entrance to siphon under dry wash
3	Gila River at McPhaul Bridge, approximately 1/4 mile below bridge in old roadbed; above drainage canal discharge
4	Principal drain from Wellton-Mohawk Irrigation District, 1.0 miles west (downstream) of U. S. Highway 95; at entrance to siphon under dry wash
5	Colorado River at Yuma, Arizona Water Co. Intake No. 1
6	Colorado River at Morelos Dam, from Arizona side, approximately 150 yards above dam
7	South Gila Drain No. 2, at discharge to Colorado River, approximately 3 miles above Yuma

TABLE II - FLOW DATA

Station Number	Agency Making Measurement	Flow, cfs. Cycle I	Flow, cfs. Cycle II
1	U. S. Geological Survey gaging station below Imperial Dam	796	797
2	Bureau of Reclamation calibrated gate at diversion to the Wellton-Mohawk Canal	558	557
3	USGS gaging station near Dome, Arizona	6.4	8.5
4	Field measurement by PHS personnel	93	96
5	USGS gaging station at Yuma, Arizona	1080	1055
6	International Boundary and Water Commission gaging station at northerly international boundary above Morelos Dam	4035	4030
7	Bureau of Reclamation Sparling meter near sampling point	1.4	1.4

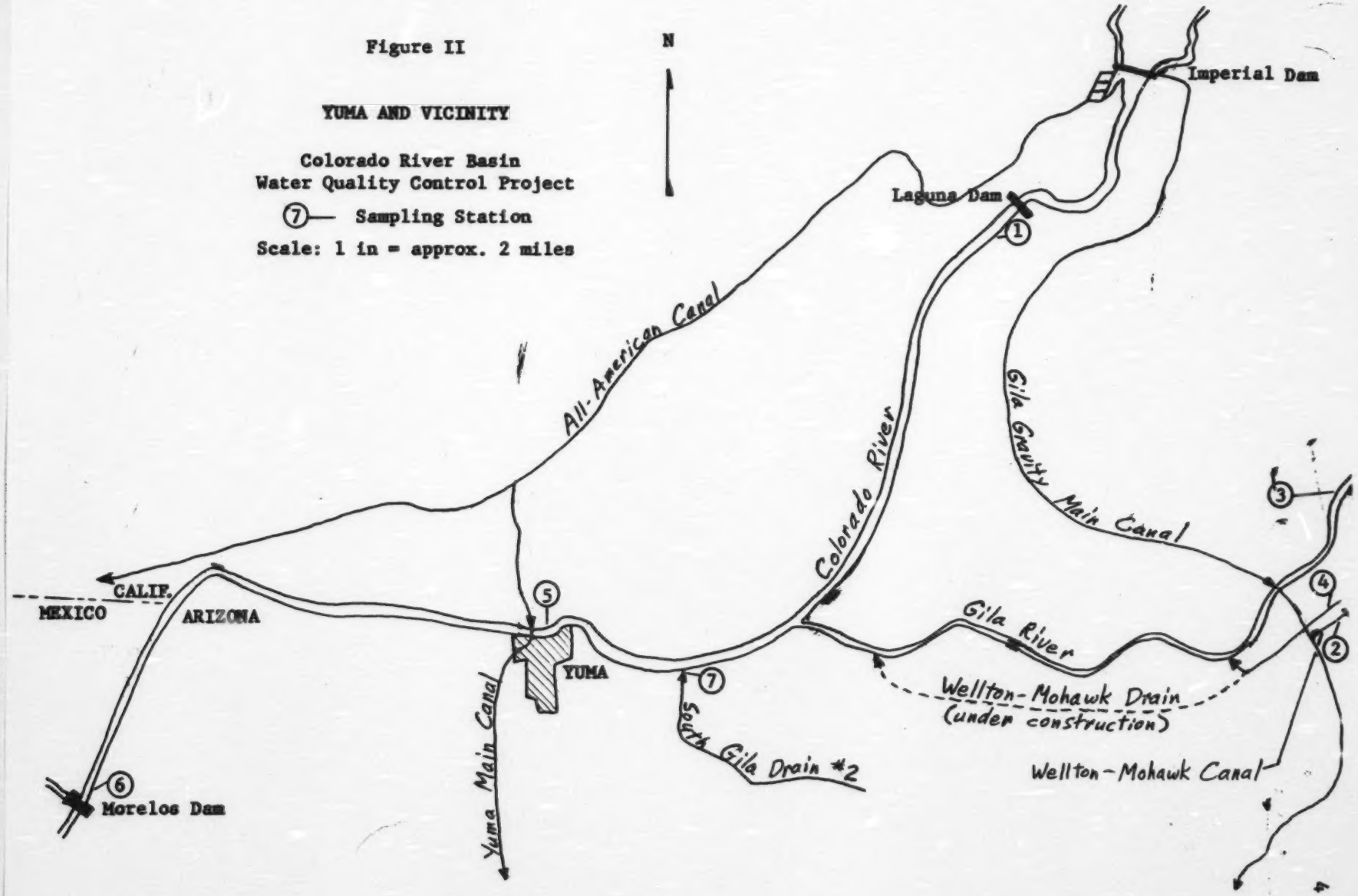
Figure II

YUMA AND VICINITY

Colorado River Basin
Water Quality Control Project

⑦— Sampling Station

Scale: 1 in = approx. 2 miles



DISCUSSION

Results of laboratory analyses of samples collected are presented in Table III.[1/] It will be noted that the poorest chemical quality is exhibited at Stations 3 and 4, the Gila River and the main drainage from the Wellton-Mohawk Irrigation District, respectively. Tabulated weights of constituents at each of the sampling stations appear in Table IV.

Flow in the Wellton-Mohawk Drain was nearly 100 cfs during the sampling period. This amounted to about 9 percent of the Colorado River flow at Yuma. Comparing certain constituents on a weight per day basis, the total dissolved solids in the drain were about 40 percent of those in the river at Yuma; the chlorides in the drain were about 56 percent of those in the river at Yuma; the sulfates were about 26 percent of the total at Yuma; and total hardness was about 37 percent of that at Yuma.

The Colorado River flow at Morelos Dam, about 5 miles below Yuma, is almost four times as great as the flow at Yuma. This is due to a small amount of additional irrigation return water coming in from the California side, but primarily from canal wasteways below Yuma, which discharge excess water from the All American Canal. Colorado River water is diverted for irrigation in Mexico at Morelos Dam. The Wellton-Mohawk Drain contributed about 2 percent of the flow at Morelos Dam. However, it contributed approximately 17 percent of the total dissolved solids, 32 percent of the chlorides, 7 percent of the sulfates, and 13 percent of the hardness.

It is of interest to compare the quality of water used for irrigation in the Wellton-Mohawk Irrigation District with that of water returned to the Gila River from the District. As shown in Table V, the return water is of very poor chemical quality. Although no direct correlation between the water quality of these flows can now be developed, the data indicate that on a gross basis the return water has been considerably degraded from the chemical standpoint.

1/ Analyses performed by National Water Quality Network Laboratory in Cincinnati, Ohio.

TABLE III

Results of Laboratory Analyses
Results in ppm except for pH
March 1961 Survey near Yuma, Arizona

Station and Cycle	Description of Location	pH	Hardness As $CaCO_3$	Ca	Mg	Na	K	Cl	SO_4	Total Dissolved Solids	Pb	B
1-I	Colorado R. below Laguna Dam	7.9	360	108	22	99	4.5	115	310	773	<.05	0.18
1-II	" " " "	8.1	370	100	29	108	4.1	110	305	777	<.05	0.20
2-II	Wellton-Mohawk Canal	7.9	390	96	36	110	4.4	110	320	769	<.05	0.18
3-I	Gila R. at McPhaul Bridge	7.6	2500	540	279	1163	14.6	2590	700	5980	<.05	1.10
3-II	" " " "	7.6	2100	460	227	875	12.0	2500	600	4725	<.05	0.88
4-I	Principal Drain from Well-	7.6	2800	580	328	1725	16.8	3350	1225	8000	<.05	1.8
4-II	ton-Mohawk Irrigation	7.6	2600	580	279	1650	16.9	3700	1225	7710	<.05	1.8
5-I	Colorado R. at Yuma Intake #1	7.9	620	152	58	320	6.5	550	400	1700	<.05	0.40
5-II	" " " " "	8.0	680	160	68	355	6.3	570	430	1740	<.05	0.43
6-I	Colorado R. at Morelos Dam	8.0	460	120	40	165	5.0	260	360	1100	<.05	0.27
6-II	" " " "	7.9	520	120	53	175	5.2	290	350	1130	<.05	0.27
7	So. Gila Drain #2	7.7	1500	300	182	1300	12.7	2450	825	5475	<.05	1.3

TABLE IV

Weights of Constituents, 1000 lbs./day

Station and Cycle	Description of Location	Ca	Mg	Na	K	Cl	SO_4	Total Dissolved Solids	B
1-I	Colorado R. below Laguna Dam	463	94.3	425	19.3	493	1330	3320	0.77
1-II	" " " "	429	125	464	17.6	472	1310	3340	0.86
2-II	Wellton-Mohawk Canal	288	108	330	13.2	330	960	2310	0.54
3-I	Gila R. at McPhaul Bridge	18.6	9.62	40.1	0.5	102	24.1	206	0.04
3-II	" " " "	21.1	10.4	40.1	0.5	114	27.4	216	0.04
4-I	Principal Drain from Well-	291	164	864	8.4	1680	614	4010	0.90
4-II	ton-Mohawk Irrigation	300	144	853	8.7	1910	634	3990	0.93
5-I	Colorado R. at Yuma Intake #1	884	337	1860	37.8	3200	2330	9890	2.33
5-II	" " " "	909	387	2020	35.8	3240	2440	9890	2.44
6-I	Colorado R. at Morelos Dam	2610	870	3590	109	5650	7830	23,900	5.87
6-II	" " " "	2610	1150	3800	113	6300	7600	24,500	5.86
7	So. Gila Drain #2	2.26	1.37	9.81	0.1	18.5	6.2	41.3	0.01

TABLE V

Concentrations, lbs./million gallons

	Station No. 2 Wellton-Mohawk Supply Canal	Station No. 4 Wellton-Mohawk Return Water
Ca	801	4840
Mg	300	2537
Na	918	14,086
K	37	141
Cl	918	29,416
SO_4	2670	10,222
TDS	6417	65,550
B	1.5	15

It is also of interest to calculate the effects of the return irrigation water from the Wellton-Mohawk District on the quality of the Yuma water supply. The figures in Table IV indicate an average of 1,800,000 lbs./day chlorides being discharged to the Gila River in the return water. If this were deducted from the 3,220,000 lbs./day in the Colorado River at Yuma, the chloride concentration would be reduced from 560 to 247 ppm, assuming complete mixing at Yuma. Actually there is doubt that complete mixing exists. Similarly the total hardness would be reduced from 650 ppm to 410 ppm.

CONCLUSIONS

The Wellton-Mohawk Irrigation District return water is apparently the principal cause of the recent degraded chemical quality of Colorado River waters below the Gila River.

The findings in this report reflect the conditions in the area near Yuma only during the period of the survey and river water quality may change with altered conditions. In view of the objectives of this Project and plans for additional irrigation development in this area, it is proposed that a continuing monitoring surveillance of chemical water quality be initiated in the Yuma area in the immediate future.